case of monarchs, traditional wintering sites in California and Mexico have been converted by development, deforestation, or agriculture. Thus, tens of millions of monarchs are restricted to 10 sites in Mexico (5 of them unprotected by regulations) and only 7 remaining sites in California. The butterflies are not yet endangered, but a major part of their life cycle is in jeopardy.

Outreach in elementary schools has improved the public's appreciation of bats. And BCI is working with mining companies to convert abandoned mines into roosts for hibernating bats, creating a human–animal partnership with mutual benefits. "This is a very important part of bat ecology," says French. "We protect [both] the bats and people with gates at the mine entrances. It gives a habitat for bats, and helps give mines a more positive image."

Pollinators may also benefit from the move toward more "natural" gardens in private homes that demand less pesticide use, as well as a 1994 Executive Memorandum issued by President Clinton that recommends the use of regional native plants, which often evolved with their pollinators in a mutually beneficial relationship, and integrated pest management, which features reduced use of pesticides on federal and federally funded properties. And science is beginning to do its part to protect pollinators, as well. In a paper published in the February 1998 issue of *Conservation Biology*, Nabhan, Bitner, Inouye, and 19 other coauthors propose supporting animal pollinator services by promoting alternative pollinators, encouraging crop breeders to consider pollinator attraction in new varieties, preserving pollinator stocks, and researching ways of increasing pollination and creating pollinator habitats in agricultural areas.

Melanoma Vaccines

Researchers are making significant progress in developing innovative treatments for melanoma, a form of malignant skin cancer that is on the rise in the United States, according to the American Cancer Society. Melanoma begins in the melanocytes, the cells that produce the skin pigment called melanin. Researchers believe that exposure to ultraviolet light damages the DNA in these cells, which results in the development of melanoma.

Scientists have been working for years to develop vaccines that treat melanoma by stimulating the immune system to attack cancer cells. The body does not ordinarily attack melanoma cells because such cells are roughly 99% normal, says Philip Livingston, head of the cancer vaccinology laboratory at Memorial Sloan-Kettering Cancer Center in New York City. Researchers have sought to identify the differences that explain why some cells turn cancerous. "We've spent many years in the laboratory trying to define and isolate the genetic elements and the genes that code for what is different on a cancer cell compared to a normal cell that the immune system can recognize," says Steven Rosenberg, chief of surgery at the National Cancer Institute (NCI).

Livingston refers to these characteristic elements of cancer cells, which include proteins and antigens, as "handles." Researchers developing melanoma vaccines replicate these handles and combine them with immune boosters, or substances that the immune system recognizes and attacks. Theoretically, linking the handles with substances known to elicit an immune response will prompt the body to seek out all handles and therewith eliminate the cancer cells. Although the practical application of such vaccines is years away, scientists are making significant advances in the area. "This is a mammoth field," says Paul Chapman, an associate attending physician and head of the melanoma section at Memorial Sloan-Kettering Cancer Center. "There are many vaccines that are being tested, and all are equally promising."

Researchers at Memorial Sloan-Kettering are working on melanoma vaccines that contain one of three replicated chemicals—GM2, GD2, or GD3—that are located on melanoma cells and that have been found to be recognized by the immune system. The vaccines combine the chemicals with QS21, an immune booster from the South American soapbark tree, and KLH, an antigen produced by the mollusk *Megathura crenulata*. Early results show an improvement in survival rates in some patients.

Rosenberg and colleagues at the NCI have chosen to work with cancer cell peptides that the immune system can recognize. They have modified the peptides so they can better bind to the immune cells—cytotoxic T lymphocytes—that attack melanoma cells. The modified peptides are then injected into the body. In a recent study published in the March 1998 issue of *Nature Medicine*, Rosenberg and colleagues reported that, when administered with interleukin-2, a medication that boosts the immune system to help slow the growth of cancer, the vaccine caused an immune system response. They also found that 13 of 31 patients showed at least partial tumor shrinkage in the lung or skin, among other sites.

Another promising vaccine has been developed by Donald Morton and colleagues at the John Wayne Cancer Institute in Santa Monica, California. Morton collected blood, tissue, and serum samples from melanoma patients for many years. Study of these samples enabled him to identify three cancer cell lines that provoke strong immune system responses. Morton is working on a vaccine that uses radiated melanoma cells containing many different handles combined with bacillus Calmette-Guerin, a known immune booster. Morton is currently conducting worldwide clinical trials on the vaccine.

New Source of Fish Fears

In the Snook Nook bait shop in Jensen Beach, Florida, snapshots of anglers holding up their prize catches attest to the rich bounty for which the adjacent Indian River is famous. A few yards from the shop, in a cramped trailer owned by the Florida Department of Environmental Protection (DEP), is another photographic testament to the Indian River's fish. These close-up shots show fish with bloody, open sores reminiscent of those associated with the toxic dinoflagellate *Pfiesteria piscicida*.

The sickened fish in the photos began appearing early this spring on the hooks of anglers fishing around the juncture of Florida's Indian and St. Lucie rivers, a brackish region known as the St. Lucie Estuary. At least 33 species of fish were affected. Although the lesions mimic those associated with the *Pfiesteria* outbreaks that have killed millions of fish in Maryland and North Carolina, the estuary apparently harbors a different culprit; nearly all the sickened fish in the estuary were found alive.

Water samples revealed the presence of *Cryptoperidiniopsis* ("crypto"), one of 10 recognized *Pfiesteria*-like species of microalgae. Karen Steidinger, a senior research scientist, and Jan Landsberg, a research scientist, both of the DEP's Florida Marine Research Institute in St. Petersburg, first identified crypto in 1997 in water samples taken from St. John's River near Jacksonville. Like *Pfiesteria*, crypto is a heterotrophic dinoflagellate that feeds on microalgal prey. Crypto coexists with *Pfiesteria* in Maryland and North Carolina, but appears to live apart from any related species in Florida.

Whether it's causing the ulcers in the St. Lucie fish, though, is not clear. Of the 2,000 known species of dinoflagellates, about 65 have been shown to produce toxins. "There's no evidence [crypto] is toxic," says JoAnn Burkholder, an associate professor of botany and aquatic ecology at North Carolina State University in Raleigh, who in 1991 helped identify *Pfiesteria*. "We don't understand much about toxin pro-

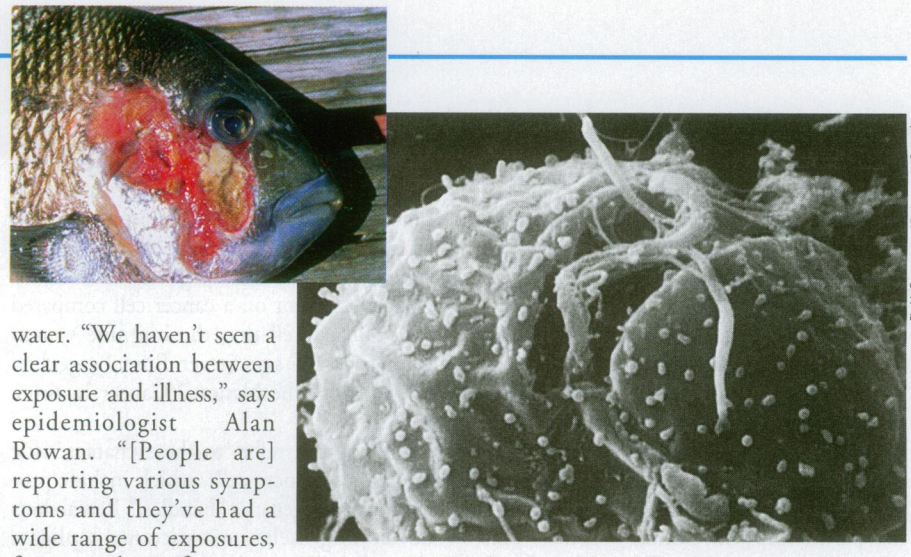
duction in dinoflagellates." Whatever is plaguing the St. Lucie fish appears to act by destroying the protective mucous coat of the fish, inviting opportunistic bacterial and fungal infections.

Burkholder, Steidinger, and other researchers are scrambling to determine whether crypto is indeed toxic, and to solve the mystery of the sickened fish. "It's extremely important from a public health perspective to know what's out there, what are its toxins and their effects," Steidinger says. Sometime this summer, researcher Peter Moeller, project leader for the marine biotoxins program at the National Ocean Service in Charleston, South Carolina, expects to have preliminary results of bioassays he's conducting to determine crypto's toxins. His findings should aid in understanding both crypto and its cousins.

According to Daniel Baden, director of the NIEHS Marine and Freshwater Biomedical Sciences Center at the University of Miami in Florida, three toxins have been associated with *Pfiesteria*-like dinoflagellates—a lipid-soluble lethal toxin, a water-soluble suspected neurotoxin, and a dermonecrotic toxin. Baden speculates that lesions found on fish killed by *Pfiesteria* may actually be caused by crypto. "People have been working with mixed cultures," he says, "but because the organisms were differentiated only recently, we haven't had time to ascribe specific toxins to specific organisms."

Some researchers hope to ward off future outbreaks by determining what caused an ancient species of microalgae to strike here and now. "We believe crypto has been here hundreds, maybe thousands of years," says DEP marine biologist Ann Forstchen. Four times over the last 20 years, the St. Lucie Estuary has suffered outbreaks of fish disease. Each followed unusually high discharges from the St. Lucie Canal into the St. Lucie River, in which the South Florida Water Management District flushed fresh water from Lake Okeechobee through the canal to prevent flooding. "There's an apparent causal relationship between massive discharges and the outbreak of ulcers," says Dan Haunert, a lead scientist with the South Florida Water Management District. Nutrient runoff into the canal is believed to promote microalgal growth while the force of the discharges is thought to push the growth up from the bottom sediment.

Although studies are incomplete, crypto appears to have little, if any, effect on humans. Two months into the St. Lucie outbreak, the Florida Department of Health had received fewer than two dozen complaints from people who suspected they had been harmed by contact with the river water. "We haven't seen a clear association between exposure and illness," says epidemiologist Alan Rowan. "[People are] reporting various symptoms and they've had a wide range of exposures, from one day to five years. There may be alternative explanations."



Florida Department of Environmental Protection

New water worries. *Cryptoperidiniopsis*, a species of microalgae, may be causing sick fish—and concerns for human health.

As freshwater discharges dropped off in April, so did the number of diseased fish brought to the DEP's trailer outside the Snook Nook. Scientists believe the fish disease event may have run its course. But Forstchen expects it to return, just as she expects the periodic return of unseasonably heavy rains. "I don't think we'll be in a position to stop [outbreaks]," she says, "but we may be able to predict when they'll happen."

Lasers for Lungs

Lung cancer is one of the deadliest cancers in the United States, striking an estimated 190,000 people and killing 160,000 annually. Smoking is the major cause of lung cancer worldwide, but asbestos, air pollution, and radon appear to contribute to this disease. By the time cancers of the lung become visible through conventional diagnostics, they frequently are too far advanced to treat successfully. Now, Xillix Technologies Corporation of Richmond, British Columbia, has developed a technology that allows much earlier diagnosis of these dangerous cancers, possibly helping to save lives. The device was approved by the U.S. Food and Drug Administration (FDA) for use on lung cancers on 20 September 1996.

The lethal nature of non-small cell lung cancer (NSCLC) lies largely in the fact that, by the time the tumor becomes visible to the oncologist, it has spread too widely to be successfully surgically removed or irradiated. Chemotherapy also has had very limited success against lung cancer. Sixty-five percent of stage I cancers, 50–55% of stage II cancers, and 30% of stage III cancers are cured. But most lung cancers are not caught until stage 3 or 4, says Tracy Lee Weigel, an assistant professor of surgery and director of the LIFE-Lung Bronchoscopy Program at the University of Pittsburg School of Medicine in Pennsylvania. For all those diagnosed with NSCLC, she says, the five-year survival rate is about 13–14%.

The new technology, which Xillix calls the Lung Imaging Fluorescence Endoscopy bronchoscopic system, or LIFE-Lung, helps doctors detect lung cancers 1–2 years earlier than standard bronchoscopy, says Weigel. This can make all the difference in catching the disease in time. "We can [detect lung cancers] before they've broken through the basement membrane [of the lung], before they've gained access to the lymphatics and the bloodstream and develop the potential to metastasize," she says.

The LIFE-Lung works according to simple principals. Tissue fluoresces when illuminated with laser light, but the autofluorescent properties of normal and malignant tissues differ. A physician uses the LIFE-Lung bronchoscope—a laser hooked to a flexible fiberoptic endoscope—to shine light onto the lungs through the fiberoptic imaging bundle of the scope. The fluorescence given off by the illuminated tissue is relayed back through a second imaging bundle and observed directly by the physician. With the LIFE-Lung, healthy lung tissue appears green and abnormal tissue appears red. In clinical trials, the LIFE-Lung was "171% more sensitive in picking up abnormalities than white light," says Harvey Pass, a professor of surgery and oncology at Wayne State University in Detroit, Michigan, and program director for the Barbara Ann Karmanos Cancer Institute in Detroit. A similar device, which uses a computer algorithm to distinguish between the subtle differences in the wavelengths of fluorescent light given off by normal and malignant tissues, is in development at Oak Ridge National Laboratory in Tennessee.

Differential fluorescence does not replace biopsy, says Bergein F. Overholt, president of Gastrointestinal Associates in Knoxville, Tennessee, a company involved in the development of the Oak Ridge